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Report to the Ranking Minority Member, Special Committee on Aging, U.S. Senate

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VA HOSPITAL CARE

A Comparison of VA and HCFA Methods for Analyzing Patient Outcomes

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Program Evaluation and
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The Honorable John Heinz
Ranking Minority Member
Special Committee on Aging
United States Senate

Dear Senator Heinz:

In response to the request made by your office, we have examined the methodology developed by the Veterans Administration (VA) to analyze mortality rates in its hospitals and compared it to the approach recently used by the Health Care Financing Administration (HCFA) in analyzing the mortality rates of hospitals treating Medicare patients.

Results in Brief

We found that the Veterans Administration modeled its approach to analyzing hospital mortality data after that employed by HCFA in its 1987 analyses of Medicare hospitals. Thus both analyses are broadly similar. To accommodate the particular characteristics of its hospital patients, VA made some changes, such as modifications in the diagnostic categories analyzed. Other refinements it made to HCFA's approach would apply equally well to Medicare analyses. Some of the improvements parallel conclusions and recommendations we made in a separate report that examines HCFA's analyses of Medicare patient outcomes, notably its statistical adjustment for the mortality risk associated with specific primary diagnoses.[1] However, VA also adjusted for two other variables, race and total length of hospital stay, which under certain circumstances could mask some differences in quality of care across hospitals. The Veterans Administration deserves credit for planning validation efforts in conjunction with the initial development of its approach; HCFA has recently begun to direct its attention to validation as well.

Background

Mortality analyses based on computerized data in hospital discharge abstracts provide a means for efficiently screening large numbers of cases in order to focus more intensive review efforts on those hospitals that are most likely to have quality of care problems. The accuracy of these analyses for screening purposes depends in part on how well they

[1]U.S. General Accounting Office, Medicare: Improved Patient Outcome Analyses Could Enhance Quality Assessment, GAO/PEMD-88-23 (Washington, D.C.: June 1988), p. 96.

use the limited data on patient characteristics from administrative data files to adjust observed differences in outcomes among hospitals for variations in the relative condition of their patients at admission. These adjustments are intended to take account of the increased mortality experienced by more severely ill patients, independent of the quality of care they receive.

HCFA released its first mortality analyses encompassing all Medicare hospitals in March 1986, and issued a second set based on a substantially revised methodology in December 1987.[2] VA published its plans to conduct similar analyses of its own hospitals in February 1988.[3]

Objectives, Scope, and Methodology

As requested, our objective was to compare the analytical approach used in the VA's ongoing hospital mortality analyses to that employed in HCFA's 1987 analyses.

We based our analysis of the VA's approach on the circular cited above that formally established its policy for conducting mortality rate analyses and on interviews with the Acting Director and staff of its Office of Quality Assurance. Because the analyses had not been completed at the time this report was prepared, we did not have the opportunity to review the results for individual hospitals. Nor did we independently check the accuracy of the data files that VA employed. We discussed our observations on the approach with officials in the Office of Quality Assurance and incorporated suggested changes where appropriate. However, as requested by your office, we did not obtain written agency comments.

Our description of HCFA's analyses summarizes material presented in our Medicare report cited above along with updated information on HCFA's plans to validate its approach. HCFA had previously commented on a draft of that report.

We performed our review in accordance with generally accepted auditing standards.

[2]Health Care Financing Administration, Medicare Hospital Mortality Information 1986, HCFA Pub. No. 01-4002, 7 vols. (Washington, DC: U.S. Government Printing Office, 1987).

[3]Veterans Administration, "FY 1986 Patient Treatment File Mortality Analysis," Circular 10-88-17 (Washington, DC: Feb. 16, 1988).

Comparison of the Two Approaches

The Veterans Administration took the HCFA approach as its point of departure, thus the two analyses have many similarities. Both produce information about the outcome of care provided in specific hospitals by examining the mortality rate of patients treated in those hospitals. Both also attempt to make the assessment of hospital mortality more accurate by comparing each hospital's observed mortality to an expected mortality rate that adjusts statistically for variation among hospitals in patient severity or condition, that is, the characteristic of their patients that are likely to affect the probability of death.[1] However, the two approaches differ somewhat in the way they measure mortality, in the factors they consider to adjust for patient severity, in their methods for assessing the difference between observed and expected mortality, and in the current plans of the two agencies for systematic validation of their results.

In addition, HCFA and VA differ in the intended use of their analyses. HCFA designed its analyses specifically to provide information to the public about the relative performance of individual hospitals. It hoped that the publicized results would lead medical and administrative staff, as well as patients, to raise questions about hospitals whose observed mortality substantially exceeded that for other hospitals with a comparable mix of patients. The Veterans Administration, by contrast, planned to use its hospital mortality analyses primarily to guide its own internal quality assurance activities. Nevertheless, VA recognized that it might have to share the results if someone outside the agency requested them, and in any case plans to publicly release them by the end of 1988.[2]

Measuring Mortality

HCFA and VA both calculate mortality for nonsurgical patients as any death that occurs within 30 days of a hospital admission (or transfer to an acute care section in a VA hospital), regardless of when the patient is discharged from the hospital. For surgical patients, VA counts 30 days from the date of the procedure; HCFA, from hospital admission.

HCFA obtained information on dates of deaths both before and after hospital discharge from Social Security files. VA drew on its own hospital discharge abstract file, the Patient Treatment File, for information on

[1]We use the terms "patient severity" or "patient condition" to refer to a wide range of demographic (e.g., age and sex) and clinical factors, including both principal diagnosis (the main reason for admission to a hospital) and comorbidities (diagnosed problems that are not related to the principal diagnosis), that could affect a patient's prospects for recovery.

[2]VA is currently considering a Freedom of Information Act request for the results of its hospital analyses.

inpatient deaths. It relied on its Beneficiary Identification and Record Locator Sub-system for data on postdischarge deaths. Because the latter file has information on some, but not all, veterans treated in VA hospitals, the VA analysis underestimated postdischarge mortality by an unknown amount.

For patients with multiple hospital admissions, both HCFA and VA analyze only the results of the last full hospital episode in the year. In our report on Medicare patient outcome analyses cited above, we criticize HCFA's decision not to examine the outcome of all hospital episodes. The purpose of both the HCFA and VA analyses was to assess the performance of individual hospitals, several of which may have cared for a given patient at different times in the year. By ignoring the outcome of earlier hospital episodes, both HCFA and VA excluded information relevant to these assessments. If some hospitals tended to provide a substantially higher proportion of the excluded hospital episodes than others, the restriction of the analysis to each patient's last hospital discharge would increase their observed mortality rates more than for other hospitals.[6]

Adjustment for Patient Severity

HCFA and VA both apply a statistical technique called logistic regression to adjust for differences in patient severity across hospitals. Both analyze separately the mortality of patients belonging to broad diagnostic categories, and both employ the results of these regression analyses to determine the relationship of various patient characteristics to the risk of mortality within these groups. Each then uses the coefficients produced by these equations to calculate the probability of death for each patient. Summing across patients treated in a given hospital generates an estimate of that hospital's predicted or expected death rate. This provides a standard against which to compare the hospital's actual or observed death rate that takes into account variations in the condition of patients that different hospitals admit for treatment. (Appendix I describes these procedures in greater detail.)

The adjustments for patient severity in the HCFA and VA approaches differ primarily in the way patients are divided into groups for separate regression analyses and in the patient risk factors they consider.

[6]Since all the patients in the excluded hospital episodes survived, their inclusion in the analysis would lower the observed mortality rate for the hospitals that treated them.

Patient Groups

HCFA developed 17 diagnostic categories based on a patient's "principal" diagnosis, which is defined as the main reason for admission to the hospital, determined after examining the entire medical record. VA does not record principal diagnoses in its Patient Treatment File; instead it identifies each patient's "primary" diagnosis, which represents the illness or condition accounting for most of the days spent in the hospital. Therefore, VA developed 14 diagnostic categories based on primary diagnoses. For purposes of adjusting for patient condition at admission, principal diagnoses are in our view preferable to primary diagnoses, since the latter may sometimes represent complications that occur following admission as a consequence of the treatment provided.

VA began with the 16 specific diagnostic categories devised for the HCFA analysis, but found that a higher proportion of VA than Medicare patients fell into the 17th residual category for "all other conditions." VA analysts therefore modified the HCFA categories, so that less than 20 percent of cases remained in the residual category. Appendix II compares the 17 HCFA and 14 VA diagnostic groups.

The VA analyses also divide patients into four groups according to whether a procedure was performed, and if so, what type. The groups consist of patients who received (1) no procedures at all, (2) surgical procedures, (3) operative diagnostic and palliative procedures (e.g., biopsy, tracheostomy), and (4) nonoperative procedures (e.g., CAT scan). However, the VA data files did not contain information that would allow analysts to distinguish between elective and nonelective surgery, a major risk indicator for surgical cases.[7]

VA conducted a separate regression analysis for patients in each of the 14 diagnostic clusters (including the residual group) within each of the four patient groups. However, VA consolidated some diagnostic categories because the number of patients within them were very small. These consolidations led to a total of 27 regression equations.

Risk Factors

Table 1 compares the risk factors that HCFA and VA entered into their regression analyses. The Veterans Administration included in its regression equations all the factors that HCFA considered and added four more: race, total length of hospital stay, the VA system-wide mortality rate for specific primary diagnoses, and the total number of additional diagnoses

[7]See Mark S. Blumberg, "Measuring Surgical Quality in Maryland: A Model," Health Affairs, vol. 7, no. 1 (Spring 1988), p. 64

(beyond the primary). It also changed HCFA's variable on transfers from other acute care hospitals to reflect instead transfers from VA nursing homes and altered the way in which it calculated previous hospitalizations.

Table 1: Risk Factors Included in Regression Analyses to Predict Patient Mortality

Health Care Financing Administration	Veterans Administration
Age	Age
Sex	Sex
	Race
Prior Medicare hospitalizations (within calendar year)	Prior VA hospitalizations (within previous 12 months)
Transfers from other Medicare acute care hospitals	Transfers from VA nursing homes
8 Comorbidities	12 Complicating conditions[a]
	Total number of additional diagnoses (beyond primary)
	Total length of hospital stay
	System-wide mortality rate for individual primary diagnosis

[a]VA included in any given regression equation those complicating conditions that a preliminary analysis showed were significantly related to mortality for the particular patient group being analyzed

VA adjusted for seven of HCFA's eight comorbidities or chronic conditions, in whole or in part, and added five others.[a] For each of its 27 regression equations, VA analysts included those chronic conditions that preliminary statistical analyses showed were significantly related to increased mortality in that group of patients. They also considered HCFA's eighth comorbidity, hypertension, but found that it was not associated with higher mortality for any of the patient groups analyzed. Appendix III compares the two lists of chronic conditions.

We have some reservations about two of the factors that VA added—race and total length of hospital stay. However, we find that its introduction of a third new variable for system-wide primary diagnosis mortality rate and its modification of the prior hospitalization variable represent a clear improvement over HCFA's approach. Our discussion of these factors follows.

Race. Our report on HCFA's analyses of Medicare patient outcomes discusses the issues raised by statistical adjustment for race (GAO

[a]VA calls these "complicating conditions," but describes them as "chronic underlying ailments," which suggests that their purpose was to adjust for conditions that existed prior to the patient's admission for acute care, and not for complications of treatment that developed after admission

(PEMD-88-23, p. 22). To the extent that differences in outcomes associated with race derive from physiolog[illegible] differences that influence the probability of death, then such statistical adjustments are appropriate. However, the adjustments that VA made for race would simultaneously mask any differences in outcomes that reflect systematic variations in the quality of care received by patients of different races. Without knowing the relative influence of physiological characteristics and discriminatory practices on racial variation in patient outcomes, we cannot determine the appropriateness of an adjustment for race.

Total length of hospital stay. The VA's adjustment for total length of hospital stay raises somewhat similar concerns. It added this variable to its regression analyses to identify patients who had been receiving long-term care before being transferred to an acute care section of the same facility.[1] However, this variable does not differentiate between the length of time spent in the hospital prior to admission to the acute care section and the number of days spent in acute care. Relatively lengthy acute care could reflect a greater severity of illness at admission, but it could also result from complications of treatment, such as nosocomial infections, that reflect poor quality care. Generally speaking, adjustment variables that relate directly to patient characteristics are less prone to this type of ambiguity than variables such as length of stay that describe the nature of the treatment provided.

System-wide primary diagnosis mortality rate. Both HCFA and VA structure their analyses around a limited number of quite broad diagnostic categories. HCFA relies on these diagnostic categories to adjust for differences across hospitals in case-mix, that is, the distribution of principal diagnoses among patients. However, since these broad categories encompass individual diagnoses that vary substantially in overall death rates, relying on these categories alone can advantage some hospitals in the analysis and disadvantage others, depending on the proportion of patients that they admit with high-risk and low-risk diagnoses within a given diagnostic category.

VA has addressed this problem by entering an additional risk factor into each of its regression equations that reflects the specific probability of death associated with a given individual primary diagnosis across the VA

[1]VA hospitals provide relatively large amounts of long-term as well as acute care. Patients shifted from psychiatric or nursing beds to acute care beds within the same hospital would not be identified by the variable on transfers, which reflects transfers from VA nursing homes.

system as a whole. VA analysts found that this variable was highly significant statistically in all 27 regression equations, which means that its inclusion consistently made an appreciable difference for the predicted mortality of individual patients. By adjusting for the variation in risk among primary diagnoses, VA made its analyses less prone than HCFA's to either an overestimation or underestimation of the expected mortality rate of hospitals as a result of differences in their case-mix within diagnostic categories.

Prior hospitalizations. VA also improved on HCFA's variable for prior hospitalizations by consistently counting all discharges in the 12 months preceding the patient's last hospital episode. HCFA, by contrast, only took account of prior hospital episodes during the same calendar year. This means that the time period within which HCFA counted prior hospitalizations varied substantially among patients, depending on when their last hospital discharge occurred in the year.

Assessing Observed Versus Expected Mortality

Both the HCFA and VA analyses assess the outcomes of individual hospitals by comparing their actual observed mortality rate to an expected mortality rate generated from the results of the regression analyses. The discrepancy between the expected and observed mortality rates indicates how much better or worse the outcomes of patients are at specific hospitals compared to outcomes of similar patients treated at other hospitals. For a number of reasons, the "true" discrepancy between observed and expected mortality for a given hospital may be greater or less than that indicated by the HCFA or VA analyses. Therefore, both approaches employ statistical techniques for identifying hospitals where it is most likely that observed and expected mortality rates are in fact substantially different.

The HCFA analyses accomplish this through a formula that converts the specific estimate of predicted mortality for each hospital into a range intended to encompass that hospital's "true" predicted mortality with a 95-percent certainty. Depending primarily on the number of patients treated by that hospital, the range can be quite narrow or large. Thus, the formula takes into account the greater uncertainty brought about by chance variation in a hospital's observed mortality rate, either overall or for a given diagnostic category, if that rate derives from a relatively small number of cases.

In addition, the HCFA formula for generating predicted mortality rates contains an "interhospital variance" term, which takes into account

nonrandom, that is systematic, differences across hospitals that are related to their outcomes but not specified in HCFA's regression equations. These include differences in patient severity that HCFA's regression analyses may not have captured. They also include variations in the quality of care provided by different hospitals. Thus, hospitals whose observed mortality exceeds their range of predicted mortality differ from the predicted by a margin that is substantially larger than would be expected given typical differences among hospitals as well as random fluctuations from year to year.

VA employs a quite different approach. First, it computes the ratio of observed-to-expected mortality for each hospital. It then calculates an upper and lower limit for this ratio, using a formula frequently employed by epidemiologists to compute standardized mortality ratios. This formula takes account of chance variation in observed hospital mortality, but not systematic variation. If the range between the upper and lower limit does not include 1.0 (which would indicate that expected mortality equaled observed mortality), then the difference between expected and observed mortality is considered statistically significant at the 95-percent confidence level.[10]

Until both the HCFA and VA analytical approaches have been tested, we cannot determine which method for setting confidence intervals discriminates more accurately between hospitals providing good and poor quality care. HCFA's formula for calculating a range of predicted mortality, which takes systematic differences among hospitals as well as random fluctuation into account, might prove advantageous if most of the systematic differences in outcomes reflect variations among hospitals in patient severity that were not accounted for in its regression equations. However, if most of the systematic differences reflect variations in quality of care, the HCFA formula would undermine effective screening of problem hospitals. The VA's confidence intervals have the advantage of being relatively simple and less novel than HCFA's, employing a well-known formula that many researchers recognize and understand.

Validation

Validation refers to a systematic assessment of the overall effectiveness of an approach in accurately locating quality of care problems. Full-scale validation requires evidence drawn from independent sources of information that are separate from the data files used for the original

[10]In other words, the probability that hospitals would have "true" ratios of observed-to-expected mortality that fall outside this range as a result of random variation is less than 5 out of 100.

analyses. Medical record reviews of a sample of cases is one, though by no means the only, source for validating evidence. At this point neither VA nor HCFA has validated the approaches employed in their hospital mortality analyses, although both are developing plans to begin this process.

HCFA published its analyses of hospital mortality rates in December 1987 without any validation of the results based on independent sources of information. However, HCFA is currently planning two validation efforts for the next round of hospital analyses scheduled for release at the end of 1988. One will compare hospital outcomes in the mortality analysis to the results of generic screen reviews conducted by Peer Review Organizations (PROs).[11] The other will involve abstracting clinical information from cases treated in a sample of hospitals to see what effect a more rigorous adjustment for patient severity would have on the results of the hospital mortality analyses.

The Veterans Administration also has two validation efforts under consideration. In one, its own peer review organizations (MEDIPROS) would conduct intensified reviews of the hospitals identified as having higher-than-expected mortality rates. VA had not yet determined how these reviews would be performed and made comparable across the different MEDIPROS when we concluded our data collection. The second effort, proposed by analysts in the VA's Office of Research and Development, would provide a more systematic validation of the VA's approach. It would examine cases from hospitals that the mortality analyses had rated as having low, medium, and high death rates. In addition, a single panel of physicians applying a standard set of criteria would review all cases. This effort, depending on whether VA decides to pursue it and what specific form it takes, could provide more comprehensive validating information than either of the two studies HCFA plans to perform.

We plan no further distribution of this report for 30 days. At that time we will send copies to the Secretary of Health and Human Services, the Administrators of HCFA and VA, and to other interested congressional committees. We will also make copies available to interested parties on request.

[11]The generic screens, which the PROs have applied since 1986 to all cases that they review, require reviewers to examine the medical record for indications of six specific types of adverse events. These include premature discharges, unexpected deaths, nosocomial infections, and drug reactions or medication errors.

If you have any questions, please call me at (202) 275-1854 or Lois-ellin Datta at (202) 275-1370.

Sincerely yours,

Eleanor Chelimsky
Director

HCFA and VA Statistical Methodologies for Calculating Expected Mortality

1. Patients are divided into groups; 17 diagnostic clusters for HCFA, 27 groups defined by procedure and diagnostic category for the Veterans Administration.

2. For each patient group, a separate logistic regression equation is estimated, including the independent variables listed in table 1. The dependent variable is individual patient mortality, coded dichotomously as alive or dead 30 days after admission, or after the procedure for the VA analysis. The independent variables are the same within the HCFA and VA analyses for each patient group, except that in the VA analysis only those chronic conditions that proved in preliminary crosstabulations to be significantly associated with higher mortality for that patient group are included in the equation.

3. For each patient group analyzed, the regression equations generate coefficients for each of the independent variables. These measure the association of that particular risk factor with patient mortality, controlling for the effects of the other factors in the equation. Applying these coefficients to the characteristics of each individual patient (age, sex, diagnoses, and so forth) permits analysts to compute the probability of death for that specific patient.

4. The expected mortality of a hospital, either overall or for specific patient groups, is calculated as the sum of the individual probabilities of death for all patients in that group. For example, if a hospital treated three patients, with probabilities of death of 0.3, 0.5, and 0.4, the number of expected deaths would be 1.2. Dividing that figure by the number of patients treated produces an expected mortality rate, in this case 0.4.

Comparison of HCFA and VA Diagnostic Categories

	Health Care Financing Administration		Veterans Administration	
Risk group	**Diagnostic category**	**ICD-9-CM codes**	**Diagnostic category**	**ICD-9-CM codes**
High	Cancer	141-160, 162-172, 174-209	Cancer	141-160, 162-172, 174-209
	Stroke	430-432, 434, 436	Cerebrovascular disease	430-438
	Severe acute heart disease	410, 427.1, 427.4, 427.5, 441.0, 441.1, 441.3, 441.5, 441.9, 785.51	Severe heart disease	398.91, 402.01, 402.11, 402.91, 410, 425, 427.1, 427.4, 427.5, 428, 441.0, 441.1, 441.3, 441.5, 441.9, 518.4, 785.51
	Severe chronic heart disease	398.91, 402.01, 402.11, 402.91, 425, 428, 518.4		
	Gastrointestinal catastrophes	551, 557, 560.0, 560.2-560.9, 570, 572-572.7, 573.4, 567, 578.0, 578.9	(See gastrointestinal disease below)	
	Metabolic and electrolyte disorders	250.01-250.4, 251.0, 251.1, 255.4, 276	Metabolic and electrolyte disorders	250, 251.0, 251.1, 255.4, 276
	Pulmonary disease	415.1, 416.0, 480-483, 485-516, 518-519, except 516.1 and 518.4	Pulmonary disease	415.1, 416.0, 480-483, 485-516, 518-519, except 516.1 and 518.4
	Renal disease	580-590 except 580.81 and 590.81	(See renal and urologic disease below)	
	Sepsis	31, 202, 223, 362, 363, 368.9, 369, 380, 381, 382, 383, 384.0-384.4, 384.9, 388, 389, 545, 790.7	(See infectious and parasitic disease below)	
	Severe trauma	806, 808.43, 808.53, 820, 821, 928, 850.2, 850.4, 851.1-851.7, 852, 839.0-839.5, 860-867, 887, 897, 900.0, 901-904, 926, 927.0, 928.0, 929.0, 942.3, 942.4, 942.5, 946.3-946.9, 947.1-947.9, 948.2-948.9, 952, 958.0, 958.1, 958.4, 958.5	(See orthopedic conditions below)	
Low	Ophthalmologic disease	360-379	Ophthalmologic disease	360-379
	Gynecologic disease	617-629		
	Low-risk heart disease	393-429, except 415.1 and 416.0 and cases in heart disease categories above	Low-risk heart disease	393-429, except 415.1 and 416.0 and cases in heart disease categories above
	Gastrointestinal disease	530-579, except 577.0, 573.1 and 573.2 and cases in gastrointestinal catastrophes above	Gastrointestinal disease	530-579
	Urologic disease	593-609	Renal and urologic disease	580-609

(continued)

Risk group	Health Care Financing Administration		Veterans Administration	
	Diagnostic category	ICD-9-CM codes	Diagnostic category	ICD-9-CM codes
Low	Orthopedic conditions	712-739, 810-838, 840-848, excluding cases in severe trauma above	Orthopedic conditions	712-739, 810-838, 840-848
			Infectious and parasitic disease	001-136, 460-466, 472, 473, 474.0, 475, 476, 478.1, 478.2, 478.5, 680-686, 790.7
			Symptoms and ill-defined conditions	780-799
			Aftercare, rehabilitation, follow-up examinations	V40-V71
	All other conditions		All other conditions	

Comparison of HCFA and VA Chronic Conditions

Health Care Financing Administration		Veterans Administration	
Condition	**ICD-9-CM codes**	**Condition**	**ICD-9-CM codes**
Cancer	141-160.9, 162-172.9, 174-208.9	Malignant neoplasms	140.0-172.99, 174.0-208.9
Chronic liver disease	571-572.8	Chronic liver disease	571-572
Chronic renal disease	582-583.9, 585-587	Chronic renal disease	581-583, 585-588
Chronic cardiovascular disease	412-414.9, 426-429.1	Arteriosclerosis Atherosclerosis	414.0, 429.2, 437.0, 440
Chronic pulmonary disease	491-493.9, 496	Chronic obstructive pulmonary disease	491-496, 500-505, 506.4
Cerebrovascular degeneration, chronic psychosis	290-290.9, 294-299.9	Cerebral degeneration	290
Hypertensive disease	402-405.99, 412-414.9		
Diabetes	250.01, 250.1-250.9	Diabetes mellitus	250.01, 250.10-250.91
		Nutritional deficiencies	260-269, 425.7
		Metabolic and immune disorders	270-279
		Alcoholism	291, 303, 425.5
		Hemotologic disorders	282, 284
		Neurological disease	330-337, 340, 341, 343, 345

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